



Coincident with the release of OrcaFlex 8.7...

It's that time of year again! Our thoughts have turned from software coding to performing all the pre-release formal testing and writing of documentation for the latest features – so welcome to the December 2005 Newsletter, coincident with the release of OrcaFlex 8.7.

The big new feature in 8.7 is the advent of fully integrated shaded graphics to work alongside the traditional wire frame. This view gives vastly greater realism and has already proved very useful in the in-house beta-test versions we normally work with. There is so much to cover in the release of this function that we have devoted one of the main articles to outlining the details. The other main article reports on some work undertaken by the University of São Paulo in Brazil, on an alternative solution for cable statics. This includes results for the touchdown zone – always an interesting area of numerical modelling.

We also have the normal spread of short articles covering some of the other main features and functionality released this time, as well as more hints and tips. In the section with some general news about us we focus on our continued expansion with brief biographies of the latest staff members to join us.

Following a couple of incidents recently, we would like to raise with all our clients the issue of dongle security. The dongle is the device holding the software licence and without this, Orcina software will not work. In fact, the total value of the software is vested in the dongle, so if the dongle becomes 'lost' for any reason it is not something we can simply replace – normal charges apply. Fortunately, most of our clients take the precaution of insuring their dongle for the value of the software licence(s) therein – we would highly recommend this course of action.

As always, we hope that the newsletter is useful and informative. If you have any comments or suggestions for future newsletters, then please do not hesitate to contact us. 🐳

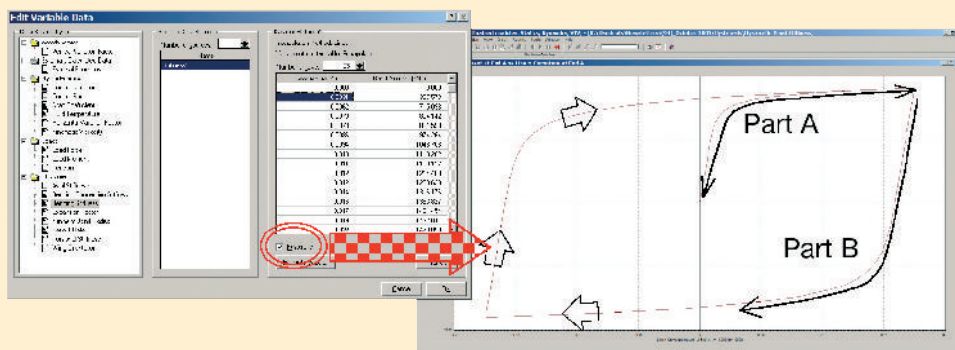
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Hysteretic Bending

Modelling for plastic deformation / cross section change....

We have added a new feature to the non-linear bend stiffness definition called Hysteretic Bending. This allows the user to define a permanent deformation in the structure caused by loading beyond a point where either the material deforms plastically, and / or internal slippage of cross-sectional layers occurs. The screen shot shows how the feature has been enabled, and a typical hysteresis curve.



For a long while now, we have been able to specify non-linear bend stiffness – Part A of the curve above. With this effected, a line will load and unload along this curve as the moment varies (very useful in its own right; also used to model bend limiters). Inclusion of hysteresis allows the history of the loading cycle to be included in the calculations, effectively allowing unloading along Part B of the curve.

So what does this mean in practice? Essentially, as a line is being loaded it will follow the curve defined in Part A. Unloading of the line will then occur along Part B. You will see from this that at zero moment there is a finite curvature defined. This represents some permanent curvature deformation of the line due to material yielding and / or cross-section layer slippage. In order to return the line to its original undeformed state, we then need to apply a reversed bend moment. This means that we have caused a permanent deformation of the structure, and this can be fully accounted for in this model. 🐳

Multi-Threading

Thread enabled software is the only way to continue to benefit from Moore's Law!

Hardware processing capacity has been increasing over the last 30 years or so according to 'Moore's law' (ie, roughly doubling every 18 months). Until recently, this has mainly been effected by increasing the clock speed of the processor, which these days means providing ever greater internal cooling. This approach has now reached practical limits, and there has been a shift from increasing clock speeds to providing more than one processing core on a single chip. In the next few years chips with increasing numbers of processing cores will become commonplace and this trend is anticipated to continue.

To allow OrcaFlex to continue to benefit from Moore's law, we have 'thread-enabled' the code. This means that by default OrcaFlex will use as many execution threads as there are processors / cores on your machine - for most models this will give the optimum use of processor resources. However, at the moment, the program cannot share the calculation for a single line between processors. So if you have a model with many lines you will see improved performance on a multi-processor machine. If you are running a single line case then you won't see any benefits, although we hope to remove this restriction in the future. 🐳

Enhanced Visualisation Provides Added Realism for Offshore Planning, Installation and Communication

The traditional OrcaFlex wire frame has served its purpose very well over the last 15 years or so, and is quite clearly the 'best in class' graphics presentation. But now the best just got better! The new shaded graphics option in OrcaFlex works alongside the wire frame view, providing a step change in visualisation technology. Here we spend a little time looking at this exciting new development.....

Shaded graphics¹ (eg, Figure 1) give a life-like representation of OrcaFlex's numerical view of the world, which is not immediately forthcoming from the familiar wire frame view. Such visualisation techniques are increasingly used in engineering, giving designers and engineers the ability to see a 'realistic' representation of the numerical data.

Previously, it was only possible to obtain shaded graphics of this quality from a graphic artist. Typically, a snapshot of an engineering system would be given some life-like qualities, probably using artistic interpretation where applicable. Later, a series of snapshots could be strung together to provide a 'movie' showing the behaviour of an engineering system. This process is time consuming, expensive, open to 'interpretation' and doesn't really enable the visual realism to influence the design and analysis of an evolving system.

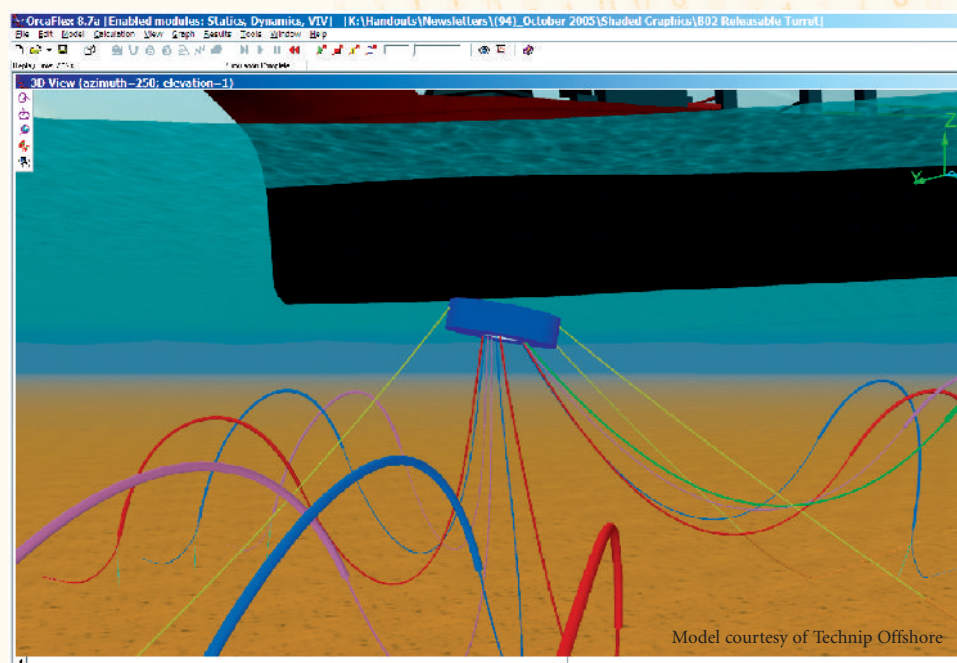


Figure 1: Modelling a Disconnectable Turret

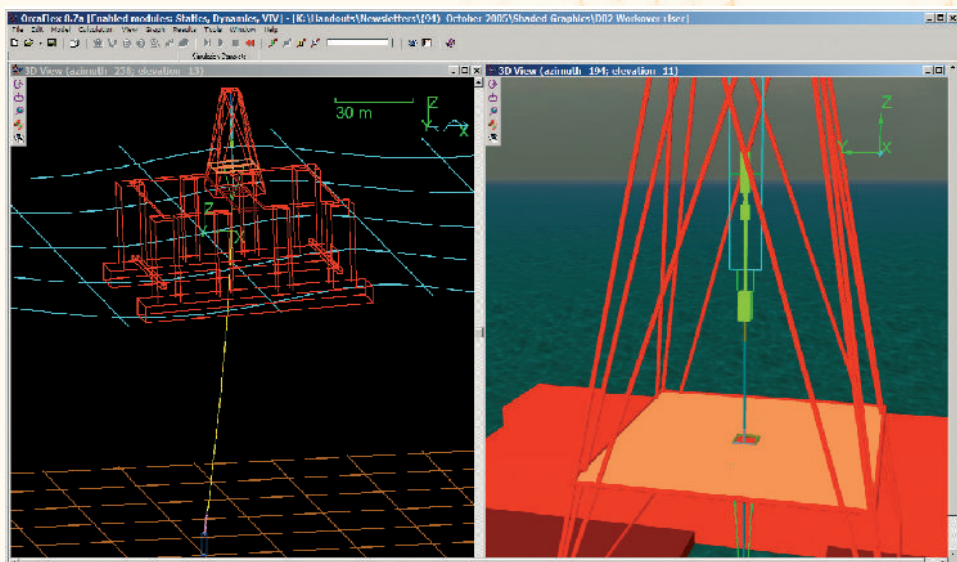


Figure 2: Workover Riser Analysis

With the advent of fully integrated shaded graphics, those days are now over. The power arising from the added realism inherent in this feature is now directly, and in real time, in the hands of the engineer.

So how do shaded graphics give the extra realism over the wire frame view? The following features of shaded graphics turn the isometric wire frame view into something quite real:

- Perspective (objects appear smaller the further you are from them, and conversely they appear larger close up).
- Hidden surface removal (objects behind are obscured by the one in front).
- The ability to use "Solid" models.
- Dimensional representation (objects appear according to the actual dimensions used in defining their mechanical properties – line outer diameter for example).
- Lighting and shading.

Having seen the features of shaded graphics, are we not justified in thinking that this is all well and good in its place, but it's not for 'serious' analysts? This is indeed a common initial reaction, but is a somewhat misplaced one. Although we have listed below the advantages of shaded graphics, the real power of its application is only truly evident when you have it in front of you and use it.

Applications

In design: During the design process, there are many instances where the shaded view can impart important information about the model. This applies at the model set up stage where both the wire frame and the shaded views are essential to aid the engineer in fast, efficient model set up. Having both easily available is a key feature of this development.

In communication: The shaded view allows much greater communication between designers and managers / non-technical parties - it's the old adage about a picture speaking a thousand words. The process of persuading clients or senior managers of the benefits of a particular design or approach can be prone to misunderstanding and confusion. However, shaded views of the same engineering data immediately convey the system, highlighting the benefits and advantages and helps to track down flaws.

In planning installations: A considerable amount of (expensive) offshore activity is concerned with installing pieces of offshore equipment. A large amount of time and effort is spent in advance, planning the necessary sequence of operations. The primary aim of the planner is to achieve the lowest cost installation commensurate with minimum risk to other in-field objects. The realism afforded by shaded graphics allows the entire planning process to be properly viewed, whilst simultaneously ensuring numerate evaluation of clearances, overload, etc.

Real time installation monitoring: Here, real time telemetry data, direct from an offshore installation campaign, can be fed into a visualisation model. This is outside the immediate remit of the existing functionality of OrcaFlex, as visualisation of this is normally done through other survey and positioning software. However, OrcaFlex has been used in these

¹ This feature as implemented in OrcaFlex is referred to as 'shaded graphics'. The term 'rendered graphics' is also commonly used to mean the same.

situations to take the telemetry data, calculate the catenary configurations and return these to the visualisation software for display.

Implementation in OrcaFlex

The shaded view in OrcaFlex uses DirectX™, a graphics library supplied with the latest versions of Windows (or freely downloadable for older versions). This allows all the objects (lines, vessels, etc) in an OrcaFlex model to have a ‘default’ shaded drawing. Default textures for the seabed and sea surface are also supplied, both with user controllable levels of transparency. OrcaFlex shaded graphics requires a graphics card which supports 3D acceleration in hardware. Most modern computers already come with a suitable card, otherwise such cards can be purchased for around USD150.

The shaded graphics view of the normal 3D wire frame is enabled through a simple key press (CTRL+G), which serves to toggle between the shaded and wire frame views. This ease of change is extremely useful in allowing the benefits of both views to feed into the design. In fact, whilst it has always been possible to have multiple 3D wire frame views open at the same time, now any of these can be set to the shaded view, allowing both views to be seen simultaneously – see, for example, Figure 2.

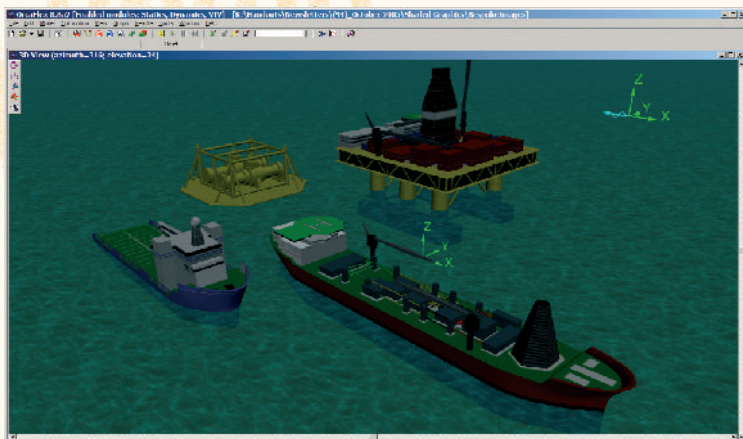
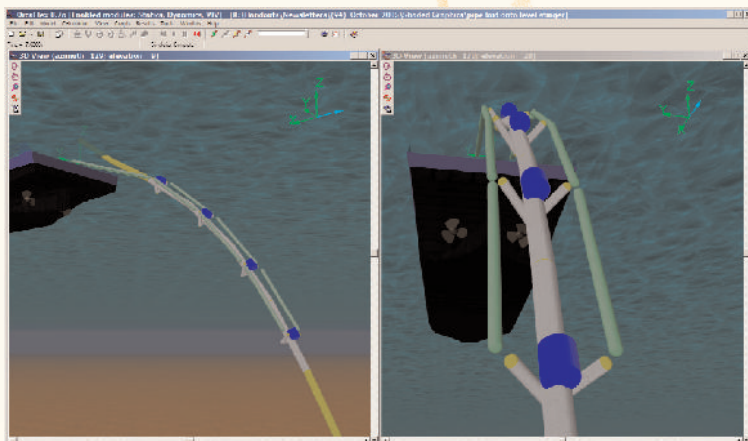


Figure 3: Shaded Drawings Distributed with OrcaFlex

In addition to the default shading of OrcaFlex objects, there is a very simple mechanism for linking in bespoke shaded drawings. For example, it may be desirable to show an OrcaFlex dynamic simulation of a particular vessel installing a particular template. This can be done by producing models of the template and vessel in a 3D graphic design package. These models can be exported as ‘.X’ files which can then be used by OrcaFlex. Figure 3 shows how this is done, using the four models we are distributing with this release. (It is worth mentioning that .X files can not only be used with OrcaFlex Vessels and 6D Buoys, but also for Shapes and Wings.)

As has long been the case with wire frame graphics, full AVI export of replays are possible using the ‘Export Video’ button on the Replay Parameters form. So now you can make a video of your favourite OrcaFlex simulation and send it to whoever needs it. 😊

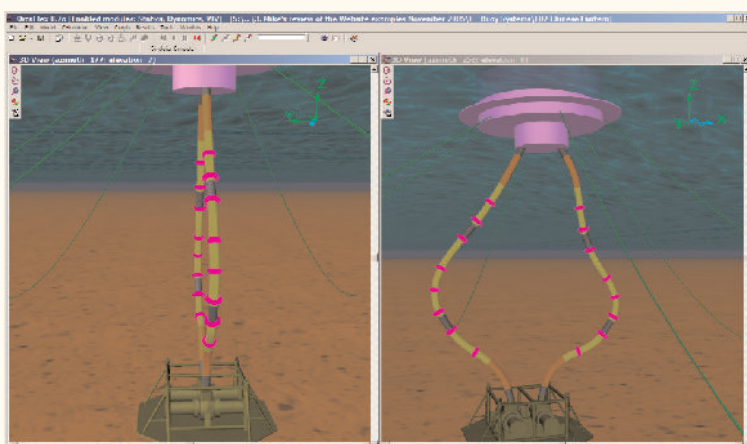


OrcaFlex Model of an Articulated Stinger

Usability

When using the shaded graphics view, there are several points to bear in mind:

- Both the shaded and wire frame views have pros and cons. For example, because of perspective, the shaded view might not be the best way to view a very large model – a towed bundle, or complete mooring spread for example. Perspective will mean that the finite widths associated with some objects (lines in particular) become hard, then impossible, to see from a distance – just as in reality. Moving the viewpoint can help, but quite often in these situations, using the wire frame view is better.
- For most OrcaFlex objects the program needs geometry data to model the object’s physical behaviour. In many cases this geometry data is all OrcaFlex needs to produce realistic visualisations of the object. For some objects this is not so. For example, an OrcaFlex Vessel object is described as a wire frame, with no information on which parts are actually solid. OrcaFlex can produce a reasonable default shaded drawing by ‘filling in’ the wire frame. Of course, as mentioned above, this default vessel drawing can be replaced by a fully shaded imported model.
- Using bespoke shaded drawings with huge amounts of detail (ie, large file sizes), will cause the image to display more slowly. Very often CAD graphics will contain vast amounts of data on the internal structure of a vessel, say. This information is just not needed in the present context, so it is important to make sure that unnecessary data is stripped out from the file.
- When displaying bespoke shaded drawings it is normal to display only that level of detail on the model which would be seen. For example, you would not display the minor details on a vessel when looking at it from several kilometres away. However, close up to the vessel you might want to display a large amount of detail. Displaying only the level of detail commensurate with the distance from the object saves unnecessary drawing effort, thereby enhancing drawing and speed. At the moment OrcaFlex doesn’t do this automatically, but we plan to address this in future releases.
- The shaded and wire frame views behave differently when ‘flying’ around them. For example in the OrcaFlex implementation of the isometric wire frame mode, you can never have the model behind you, but this is quite possible in the shaded graphics mode. If you zoom out then it is possible to lose sight of the model because of perspective! In this case, the wire frame mode can be used to set a view that allows the model to again be seen in the shaded mode.



OrcaFlex Model of a Chinese Lantern

Conclusions

The use of fully integrated, 3D shaded graphics in OrcaFlex allows the user the maximum flexibility to take advantage of this technology. In the future, this will be instrumental in the better planning and demonstration of field installation procedures, and in communicating designs and concepts to senior managers and non-technical parties. 🐳

Further Validation of Touchdown Modelling



Touchdown modelling is a somewhat tricky issue, and there are different views as to the capabilities of various software packages to model this. Continuing our theme of locating independent validation of OrcaFlex, this article is a summary of a paper² recently presented at OMAE 2005. Here, the authors (both from the Department of Mechanical Engineering, University of São Paulo, Brazil) have used OrcaFlex to benchmark a new numerical scheme they have devised for the solution of cable statics with bending stiffness. Agreement between the two approaches is remarkably good as this article shows:

Introduction

The premise of the reported study is that direct numerical integration of the governing set of ordinary differential equations (ODEs) can present stability difficulties when bending stiffness is included. The authors propose to avoid these difficulties by solving the ODEs for an ideal cable, to which they then apply an analytical correction to account for bend stiffness in zones of interest (touchdown, for example).

The authors have already done previous work in this area, based on the case of an ideal cable (one with infinite axial stiffness, zero bend stiffness, and which ignores friction with the seabed). They have shown that numerical integration of the governing ODEs for a 2D model of an ideal cable, then corrected for bend stiffness with analytical expressions, are very good.

However, in attempting to extend this approach to 3D, the analytical expressions for the bending stiffness correction become too complex and must be solved numerically. Noting that the point of the investigation was to avoid direct numerical integration if possible, the authors return to tackling the issue of direct numerical integration of the original set of governing ODEs.

They then compare results from this new method with results from an equivalent OrcaFlex model.

Numerical integration of Governing ODEs

After discussing the difficulties associated with extending their 2D approach to 3D, the authors discuss integrating this set of equations using standard ODE solvers, and they point out the numerical difficulties discovered in taking this approach.

The authors then present a different scheme to perform the integration. It is based on sequential integration of small lengths of the cable. Taking this approach and performing a stability study, the authors were able to find stability regimes for the proposed method.

Having studied this and understood the range of numerical stability, the authors have then proceeded to apply this to a real case.

Comparison with OrcaFlex

The authors have used OrcaFlex as their tool against which to benchmark their new scheme. For a practical comparison example, they consider a lazy wave flexible riser. A current profile that changes magnitude and direction

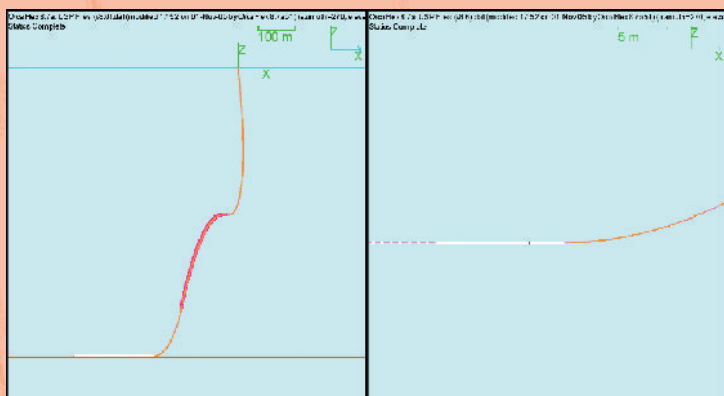


Figure 1: Elevations Showing Global and Touchdown Views

with depth was included. The case has been modelled in OrcaFlex and is shown in Figure 1 below:

The OrcaFlex model in Figure 1 has both the ideal model (no bend stiffness) and the model with bend stiffness superimposed. However, on either scale shown above, there is no discernible visual difference.

In Figure 11 of their paper, the authors present 3 curvature range graphs for the whole length of the line. At this scale the curves are barely distinguishable, with each curve corresponding to results for:

- an ideal cable (no EI),
- results from their new method (ie, with EI), and
- OrcaFlex results with EI.

Figure 12(a) of their paper shows the same three curvature plots, but with more resolution around the touchdown area - arc length from 225m to 235m (measured from the anchor). It can be observed that even on this very refined scale, differences between the OrcaFlex results and the results from the author's new method are barely perceptible.

In Figure 2 below, we have generated two OrcaFlex curvature results for two of the cases, (a) and (c) above, presented in Figure 12(a) of their paper. We have shown these using the same scale as Figure 12(a), and for obvious reasons, we cannot include the results from the author's new method.

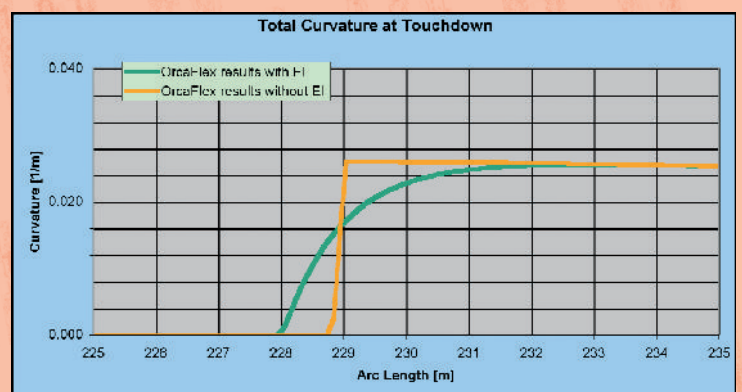


Figure 2: OrcaFlex Curvature Results for Touchdown Zone

However, the curves in Figure 2 herein are identical to those presented in the paper, excepting that the ideal case here shows a small discretisation level slope at the touchdown point.

There are 3 key points raised in the discussion section of the paper:

- Numerical integration of the ODEs allows the inclusion of bend stiffness to be accounted for.
- When compared with OrcaFlex, the same results are obtained. To quote the authors:
"This is an important fact, as the same results were achieved by two distinct numerical methods."
- Computation time for numerical integration of the ODEs describing the static problem was 2 hours on a P4 3.2GHz computer.

It is worth pointing out that the OrcaFlex static convergence for both lines took a matter of a few seconds for the same case, even for a model with two lines in it (no EI and finite EI)!

Conclusions

From our point of view the two leading conclusions to be drawn from this work are:

- We have found another independent validation example of the numerical model in OrcaFlex, and
- That touchdown modelling in OrcaFlex is an accurate representation of the underlying physics. 🐳

² 'A Numerical Method to Solve the Three-Dimensional Static Problem of A Riser with Bending Stiffness', Lauro Massao Yamada da Silveira and Clóvis de Arruda Martins, University of São Paulo, Brazil. OMAE05-67130.

Continued from page 1

Also known as the Bellmouth.....

Edit Shape Data: Shape 2

Name:

Can move: ☒

Shape:

Size:


Diameter

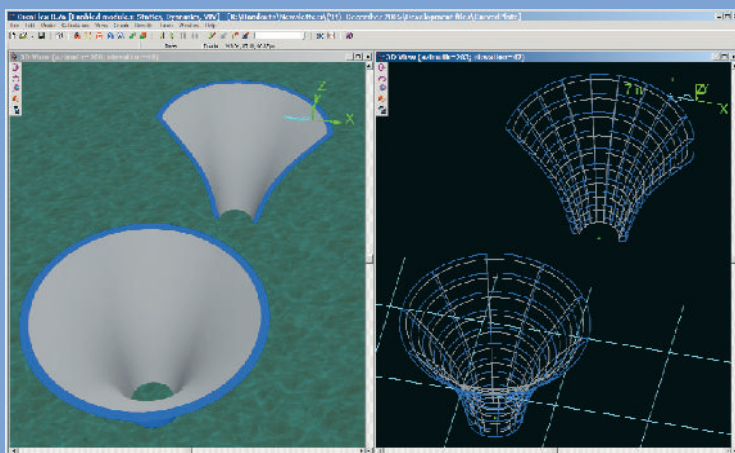
	Value
Diameter	100

Position

	Value
X	100
Y	100

Color:

Obviously, these are just the thing for modelling bellmouths, but we have also used them to define mating cones during lower-to-connect operations. These shapes also have the ability to set the included angle of revolution which we have found provides useful alternatives to the modelling of chutes and troughs on mid-water arches. 




The easy way to get it right all the time.....

[illegible]

These changes make the setting of time steps much easier and less error prone. By letting the program determine the time steps you are now free to concentrate your thoughts on designing and analysing your system. This is such a good feature that we can't imagine why we didn't implement it before. We've already found this really useful around the office – we hope you will too. 🐢

Regular loadcases from irregular seas....

The tool is essentially a self-contained sub-program within OrcaFlex with its own menus, data input, and results. Any OrcaFlex process active in the main window is paused until the wave scatter form is closed and the wave scatter conversion tool has no effect on existing OrcaFlex data. The data set up through this tool can be saved in a self-contained file with the ".scf" extension. 

The OLM monitors the current number of OrcaFlex licences claimed on a network in real time...

You can obtain information on each licence claimed that includes:

- Program information: which modules are being used (OrcaFlex, VIV Toolbox etc.), the version, and the location of the program which has claimed the licence (usually this is OrcaFlex.exe but it can be Excel.exe for the OrcaFlex spreadsheet for example).

The OLM can be downloaded from our website at:
www.orcina.com/Support/OrcinaLicenceMonitor.

Simulation speed-up: The next release of OrcaFlex will be made when we have completed the implementation of an implicit time integration scheme. The addition of an implicit integrator will be a major enhancement to OrcaFlex - but a key benefit of this is that OrcaFlex will also retain its explicit integrator, meaning the users will get the best of both worlds.....roll on a new dawn. 😊

New Staff

As we reported in the last newsletter, increased demand for our products and services had led us to recruit more staff. We're delighted that this trend continues, and that we have been successful in recruiting two more members of staff whom we're very pleased to welcome onboard:

Stéphane Rion joined Orcina in April 2005 as a mathematical modeller. Stéphane obtained a Masters in Applied Mathematics in Paris XI University which included a 4 month internship at Renault working on optimisation of the fuel ignition timing process. After this came a Diploma of Engineering in mathematical modelling from the School of Engineering at Bordeaux University. This included 2 internships, one with the French Army Research organisation studying tank turret response to environmental loading, and then with the water company Suez designing neural networks for the prediction of water consumption. Stéphane then moved to London working for a start-up company designing medical imaging software, working on mathematical algorithms to assist the diagnosis process. Then came a 2 year stint with Autonomy Ltd in Cambridge as a R&D engineer developing algorithms for a large vocabulary speech recognition engine.

Renaud Guéret joined Orcina in July 2005, working within the consultancy team at Orcina. Renaud studied at Ecole Supérieure des Ingénieurs de Marseille (ESIM), specialising in offshore technology. At the same time he undertook preparatory studies necessary for entering the PhD programme. During his final training period he worked for 6 months with Principia R&D. His PhD, from the Technical University, Delft, is in applied mathematics specialising in hydrodynamics.

From there, he joined Bureau Veritas Research department in Paris. He worked there for 2 years on sea-keeping analysis, slamming of FPSOs and impact of fluid on inner walls of LNG carriers.

Newsletters by email

We have finally 'persuaded' our system to account for requests for newsletters to be sent out by email only. So if you would like to start receiving a copy of our newsletter electronically (this would be a pdf of what's presently before you), then please just let us know.

User Group Meetings

At the time of writing we have just completed all of the 3 planned User Group Meetings for this year. As usual, the meetings have resulted in very positive feedback, both for the new features released over the last 12 months or so, and for our future plans.

Due to the great response to these, we are planning to expand the number of locations where we hold User Group Meetings. In addition to our 2006 plans for UGMs in Aberdeen, Houston, Stavanger and Paris, we also intend to hold meetings in Rio and Perth. Please keep an eye on our website for further details.

Training Courses

Our activity on this front continues to grow, continuing with well established Open training courses in Houston, and now in Aberdeen and Paris. Although there is a great deal to get through in a relatively short time, the course content together with the relaxed and informal atmosphere have proved very successful. More information on Open training courses can be found at www.orcina.com/Support/SoftwareTraining. ➤

...Right clicking on the Objects box on the Results form, allows you to view by Types or Groups. We're sure that many of you will be using the Groups facility on the model browser. This same view can be adopted in the Objects box on the Results form for a consistent view of the objects in your model.

...That the Locate function (shortcut=F3), so useful in the wire frame view, also works in the shaded graphics mode. You can visualise objects you are locating either by having that object (or Group of objects) flash several times, or by having all other objects temporarily hidden (see Tools | Preferences | 3D View for setting the locate option).

...Rotating and translating in the 3D view, either wire frame or shaded, can now be done by using CTRL and mouse left button click+drag for rotation. Using SHIFT instead of CTRL with mouse click+drag effects translation. After a bit of practice, this is a really fast and effective way to move around your models.

...Simulation time columns have been added to vessel and winch data forms. You see this when control data is set on a stage by stage basis. This allows the user to see at a glance the cumulative time at each of the stages when setting control data for these objects.

...Pressing F12 now gives an integrated calculator on all data forms. As well as the convenience of being able to do minor quick 'sums', it also allows you to paste the current value of the calculator directly into the selected cell if you close it using the F12 shortcut (or use the normal cut+paste options).

...Bend Limiters (articulated devices which rotate to a specific curvature and then stop) must be capable of withstanding the maximum bend moment from your simulation ($M = R \times P$, where R is the locking radius). OrcaFlex reports the load P, calling this the 'Bend Restrictor Load' – note that this is also sometimes known as 'pseudo-curvature'.

...It is often desirable to model lift forces on plate-like structures on templates, end terminations, etc. For a long time now, you have been able to model these in OrcaFlex by using Wing objects connected to a 6D Buoy.

...Another frequent application of 6D Buoys is as a frame of reference to which other objects are to be connected - this usually requires the setting of nominal properties for the 6D Buoy. To make this easier, we have added a button to the 6D Buoy data form to set all the properties to negligible values.

...You are now able to specify a vertical wind variation factor as a function of height above MWL. This data is set in the variable data structure. ➤

Orcina - Out and About

Exhibitions, User Group Meetings and Training Courses:

For all these events please see the Orcina website (www.orcina.com) for the most up to date information: Orcina will be present at the following Conferences / Exhibitions during 2006:

- **Oceanology International, 21st to 23rd March 2006, ExCel London (Stand no: 450)**
- **OTC, Houston, 1st to 4th May 2006.**

We will also be holding OrcaFlex User Group Meetings during the Autumn of 2006:

- **Aberdeen, September 2006**
- **Rio, October 2006**
- **Houston, October 2006**
- **Perth, November 2006**
- **Paris, November 2006**
- **Stavanger, December 2006**

Our OrcaFlex Open training course schedule for 2006 looks like this:

- **Houston, April 2006 in the week prior to OTC, and**
- **Open training courses immediately following the User Group Meetings outlined above.**

We will update these details in the next Newsletter, but for the latest information please look on our website, or contact us if you just want to ask directly.

